

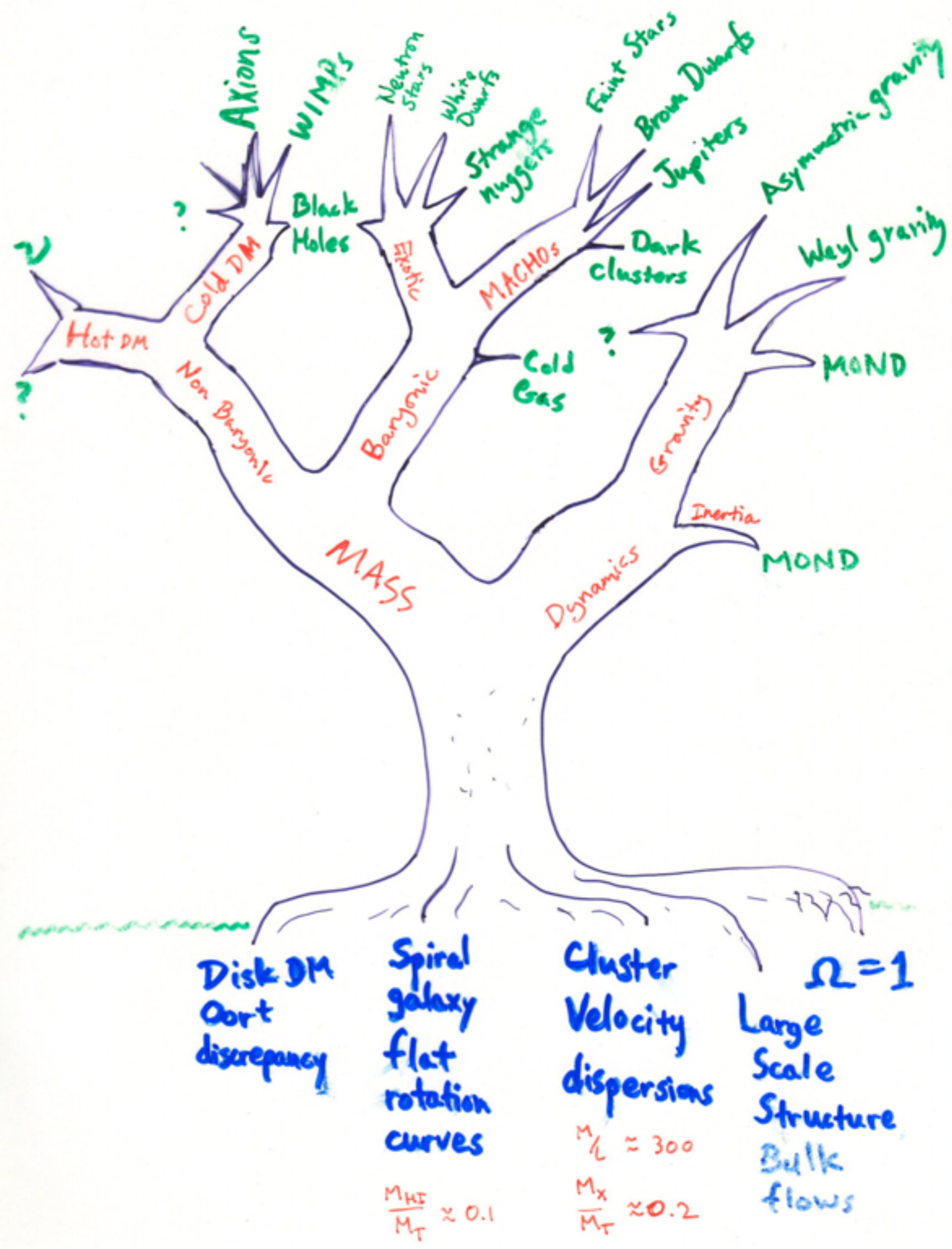
# DARK MATTER

ASTR 333/433

DARK MATTER HALO  
ASSEMBLY & SHAPE  
BARYONIC EFFECTS

Homework 2 Due Feb. 25

Midterm March 1



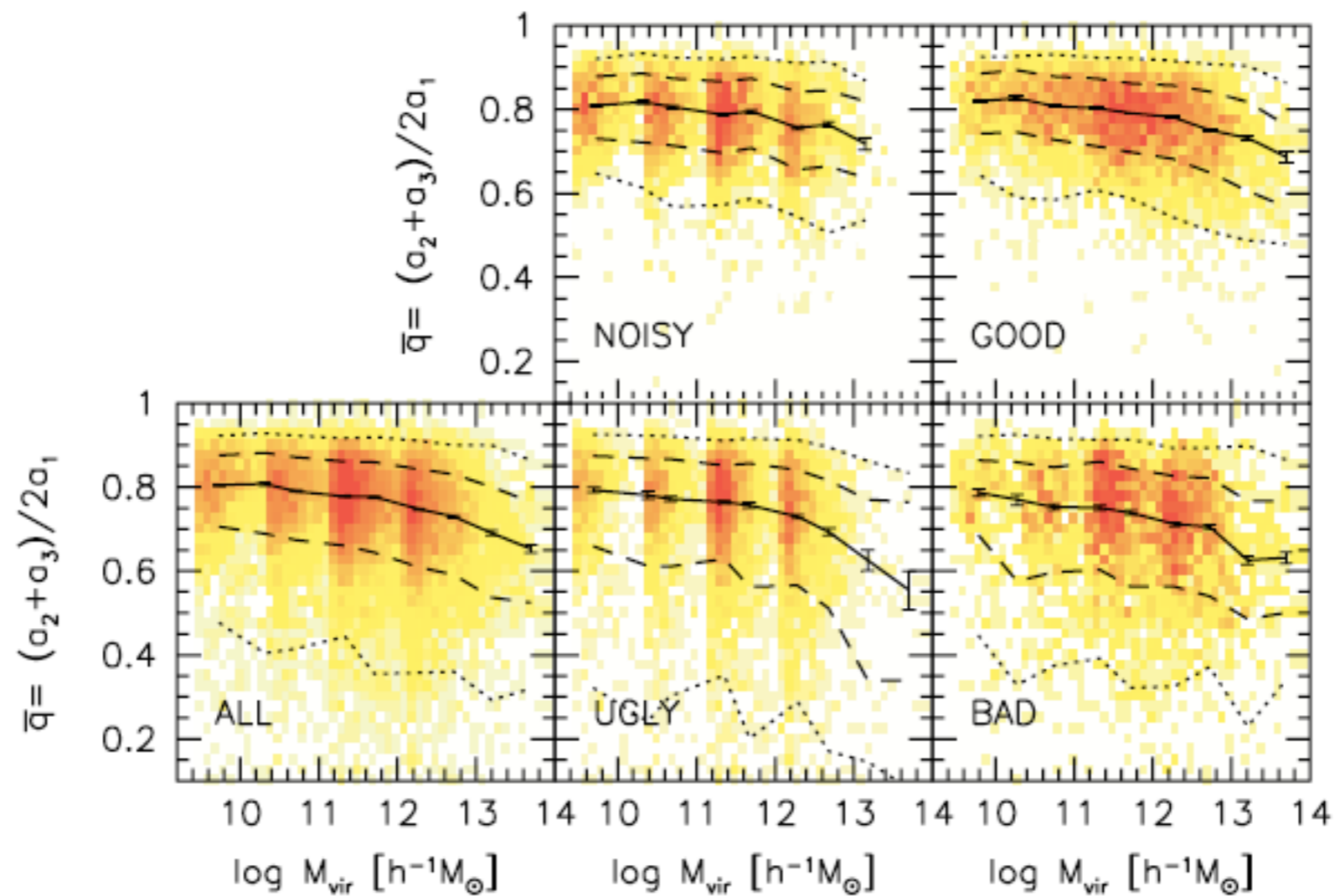
NFW  
shape

NFW halos triaxial. More massive halos less round

perhaps because they are still building up hierarchically ?

Maccio et al (2007)

*Concentration, spin and shape of dark haloes* 63



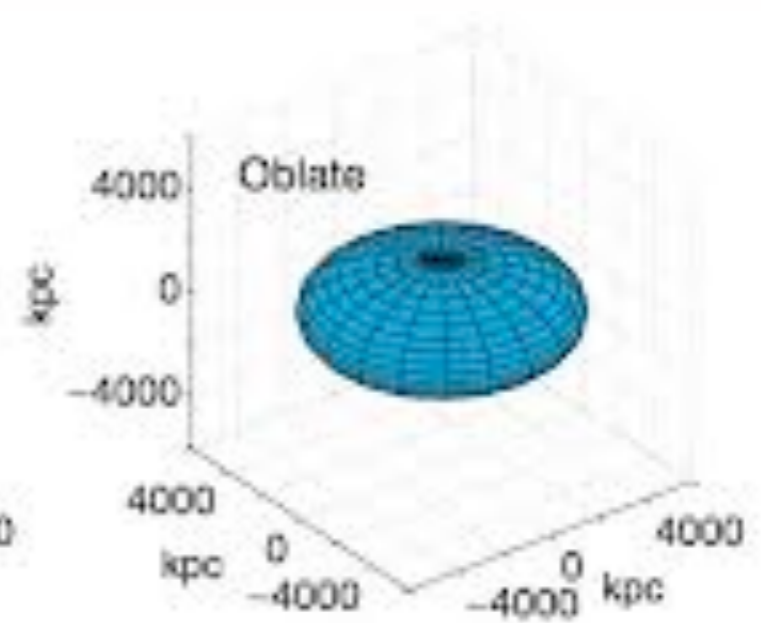
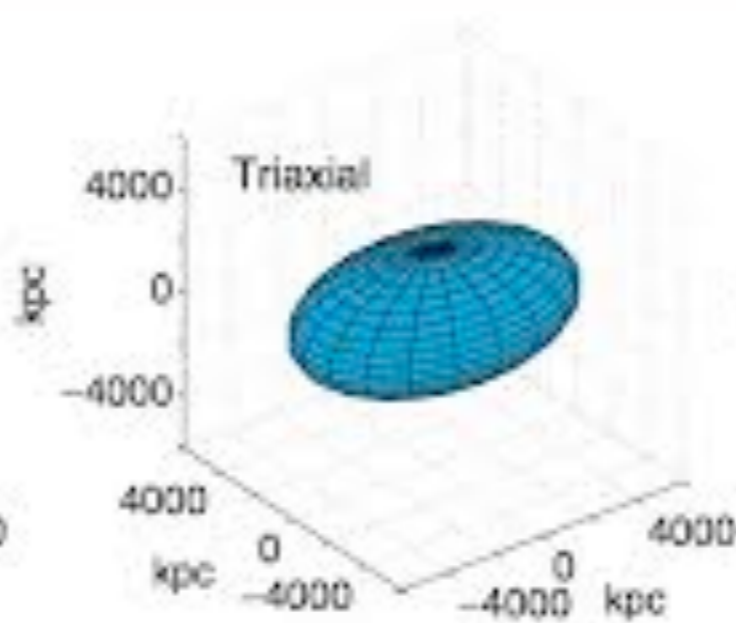
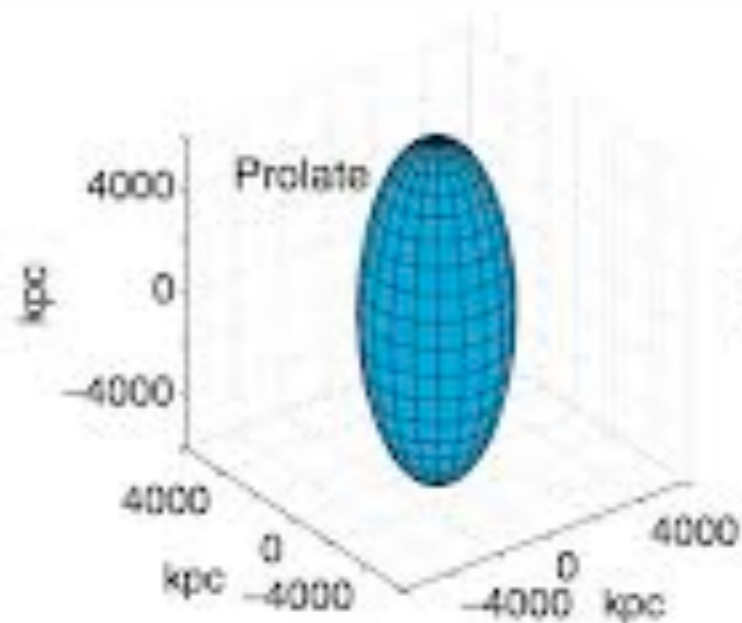
**Figure 6.** Relation between  $\bar{q}$  and  $M_{\text{vir}}$  for different subsamples of haloes. The solid lines show the 50th percentile, dashed lines show the 16th and 84th percentiles, and the dotted lines show the 2.5th and 97.5th percentiles. The error bar gives the Poisson error on the median.

# shape

prolate

triaxial

oblate



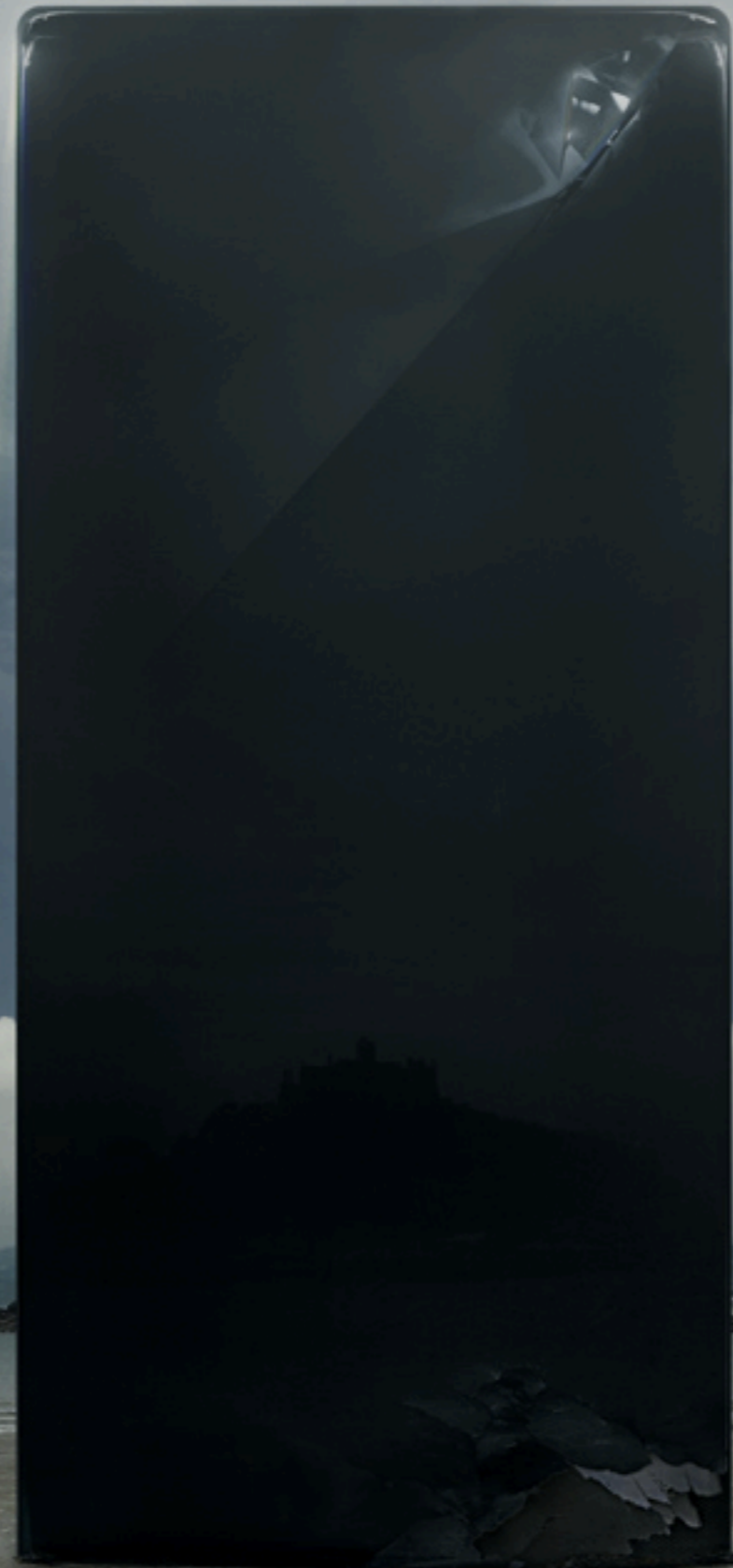
$$a > b = c$$

$$a > b > c$$

$$a = b > c$$

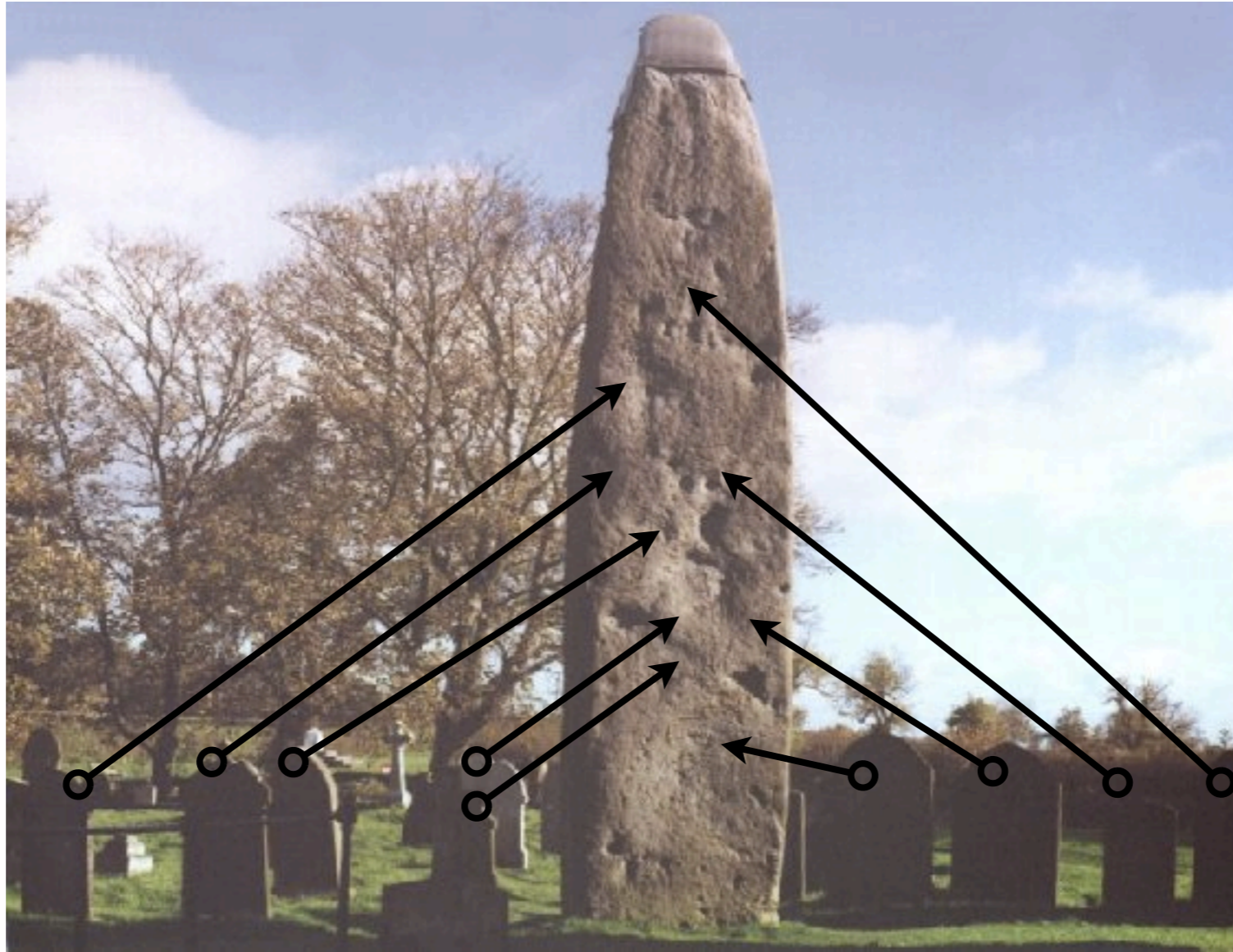
Simulations blobby and even more complicated

# Monolithic Galaxy Formation



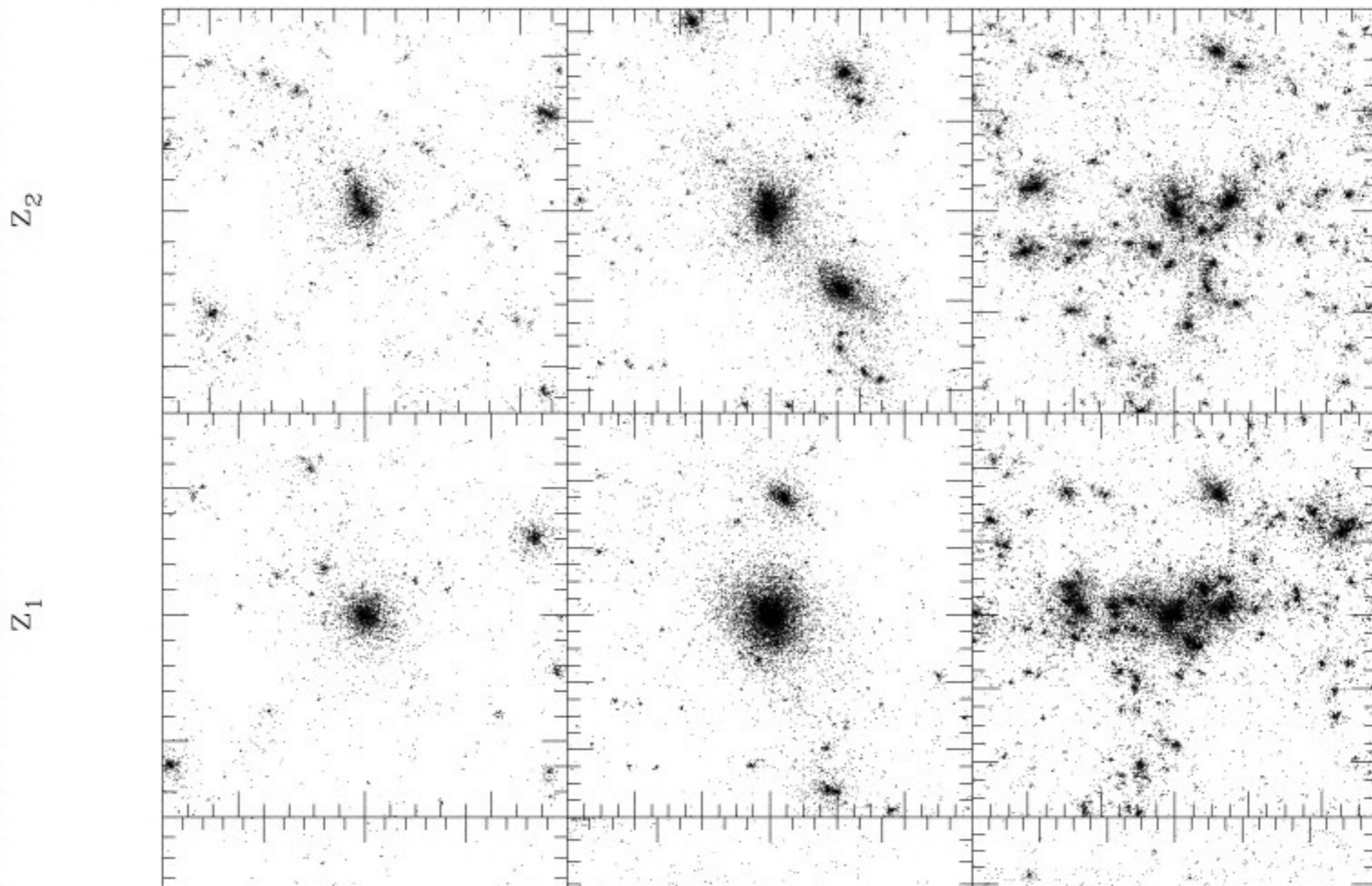
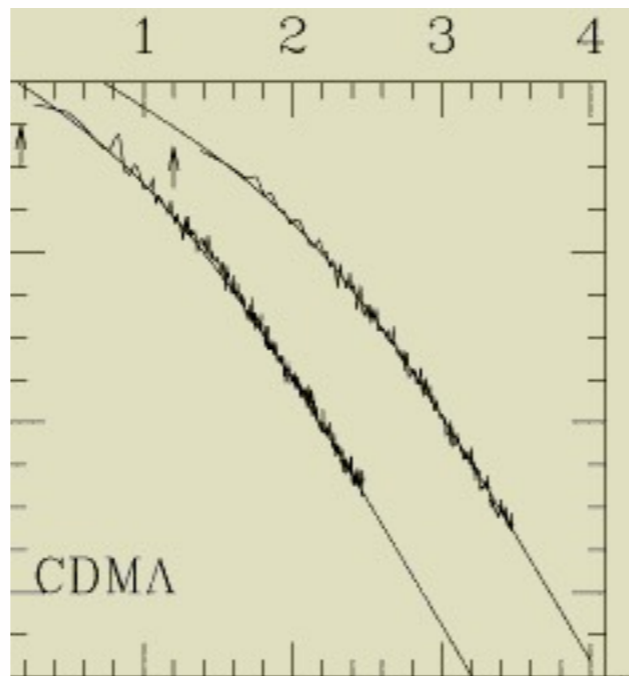
one big dark matter halo

# Hierarchical Galaxy Formation



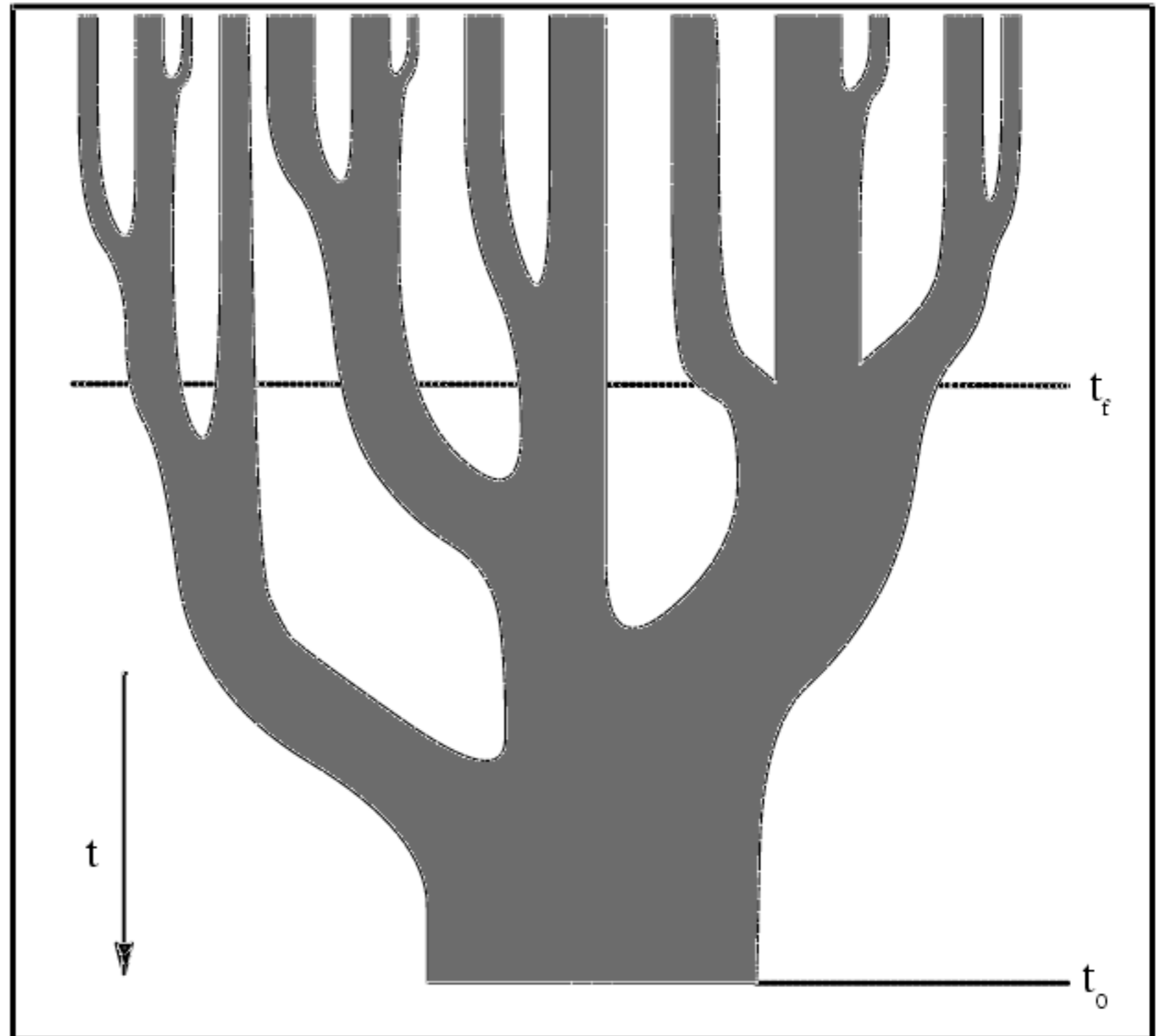
many little dark matter halos  
merge to form  
one big dark matter halo

NFW



Hierarchical  
galaxy  
formation  
(*not* monolithic)

Small objects  
conglomerate to  
make big ones



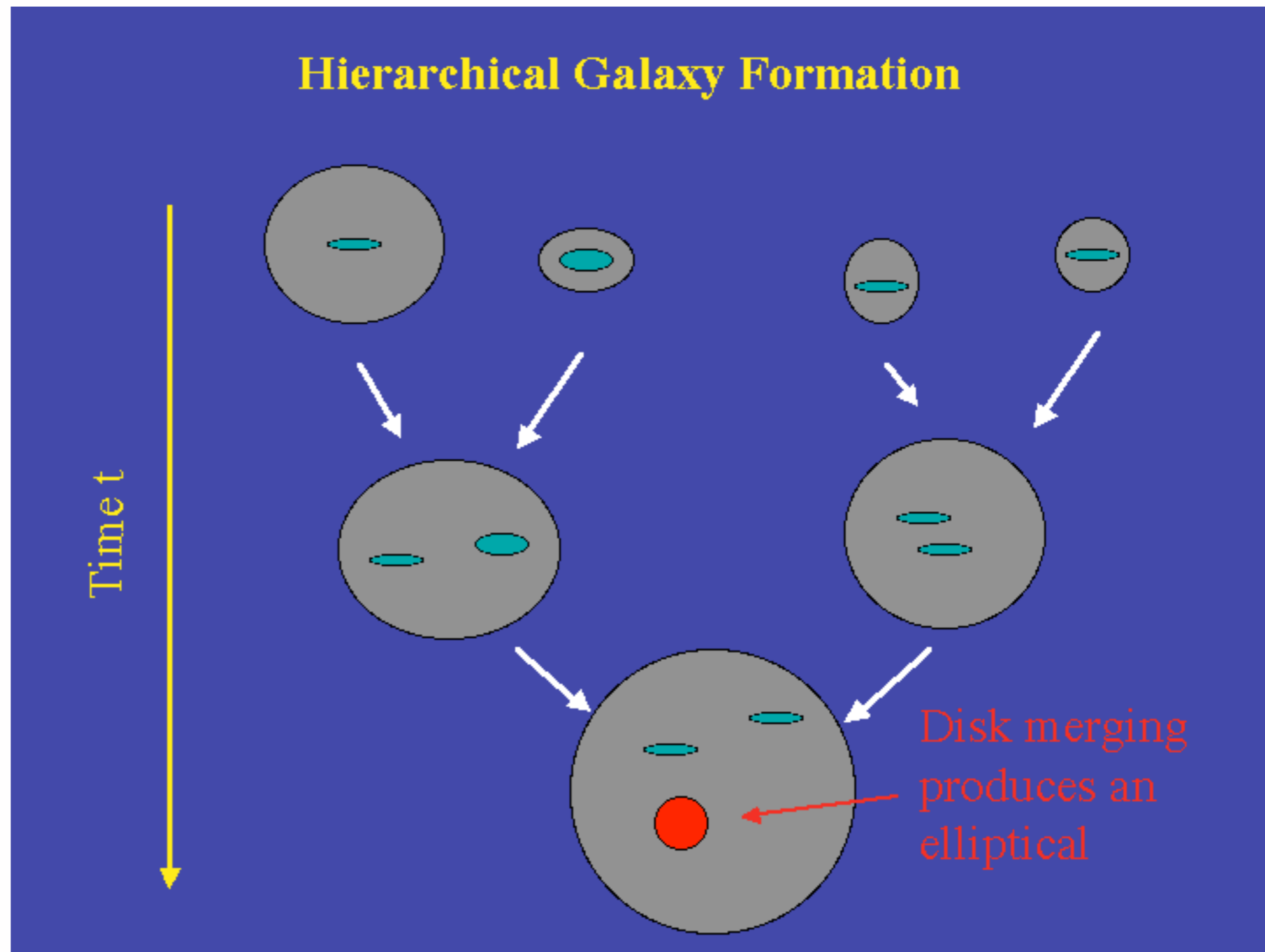
**Figure 6.** A schematic representation of a “merger tree” depicting the growth of a halo as the result of a series of mergers. Time increases from top to bottom in this figure and the widths of the branches of the tree represent the masses of the individual parent halos. Slicing through the tree horizontally gives the distribution of masses in the parent halos at a given time. The present time  $t_0$  and the formation time  $t_f$  are marked by horizontal lines, where the formation time is defined as the time at which a parent halo containing in excess of half of the mass of the final halo was first created.

Gray: dark matter halos

Blue: gas rich disks

Red: elliptical merger remnant

sometimes it is imagined that a disk re-forms around an elliptical to form a bulge+disk system like and Sa galaxy



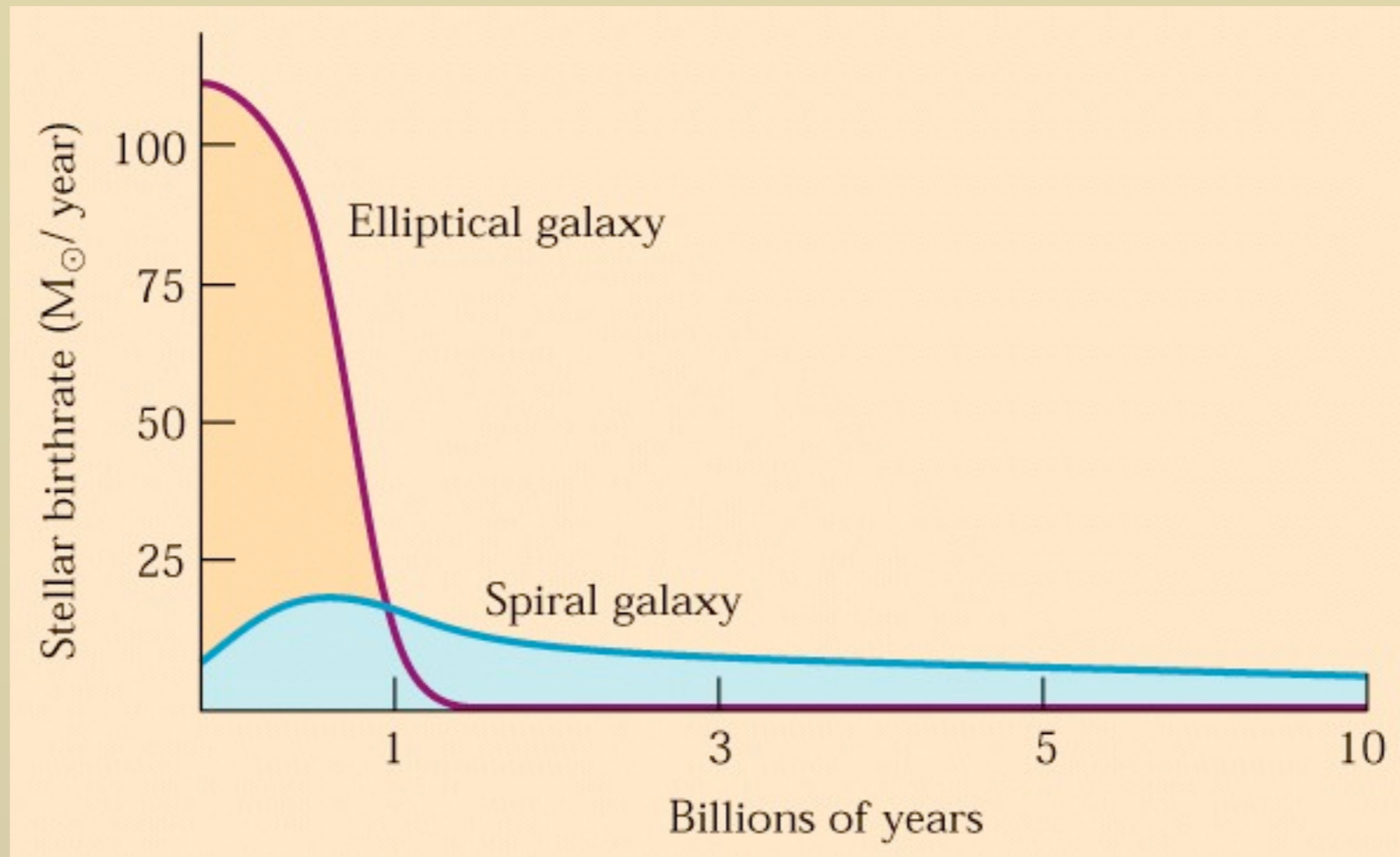


# Generic Star Formation History

Elliptical



old stars



Spiral



old stars  
young stars  
cold gas